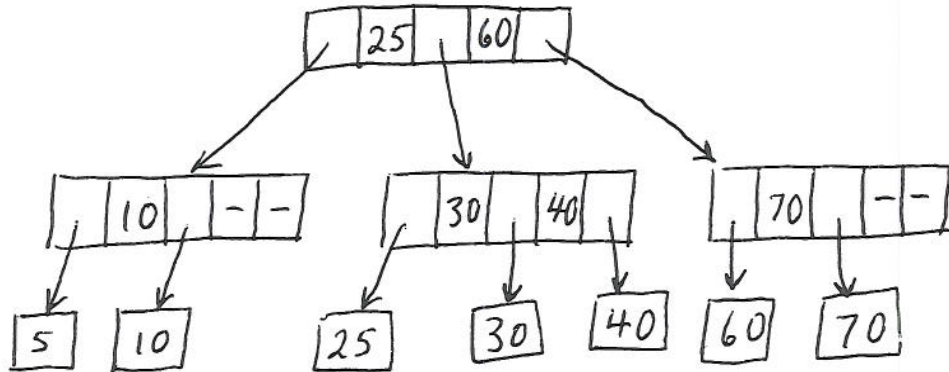55 minutes   Closed Book   Mar. 19, 2004

Marks

1.

2   (a) Considering the general properties of 2-3 trees, what are the most important properties?

3   (b) Give the 2-3 tree that results from inserting 50 into the above 2-3 tree. Only key values are shown in the tree.

3   (c) Give the 2-3 tree that results from deleting 10 from the above 2-3 tree. Note that the deletion is from the 2-3 tree shown above, not from the answer to part (b).

3   (d) Give the 2-3 tree that results from deleting 60 from the 2-3 tree that you gave as your answer to part (c). Note that the deletion is not from the 2-3 tree shown above.

14   2.   Suppose that there exists a class called *WT_BAL_TREE [G]* for a weight-balanced tree where the activity count of an item is used to estimate its probability. Assume that *WT_BAL_TREE [G]* is a descendant of *LINKED_SIMPLE_TREE_UOS[G]* so it has the following features:

make	initialize (lt : like Current; x : G; rt : like Current)
root_item : G	out : STRING
is_empty : BOOLEAN	is_full : BOOLEAN
root_left_subtree : like Current	root_right_subtree : like Current

In addition, assume function *root_count : INTEGER* returns the activity count for the item at the root of the tree.

Give the Eiffel code for a class that is a descendant of *WT_BAL_TREE [G]* and adds an *INTEGER* function called *num_with_count (i : INTEGER)*. The function is to return a count of the number of items in the tree with activity count at least as large as *i*.

1

11   3. Consider the following proposition. In the sequence of items obtained by an inorder traversal of a non-empty binary tree, the first item and the last item of the sequence are always stored in leaves of the tree.

Recall that an inorder traversal processes nodes in the order left subtree, root, right subtree.

(a) Give a binary tree where the proposition is false. Hint: read part (b).

(b) In assignment #6, question number 4 considered family trees. Recall that a family tree is a binary tree such that every node has either 0 or 2 children, i.e., no nodes have only 1 child. Prove by induction that the proposition is true for all family trees.

7   4. Consider a BOOLEAN function to test a binary tree to determine whether it is properly ordered or not. List the situations that should be tested in order to check whether the function is correct.

7   5. Consider the double hashing technique for a hash table. Recall that to use this technique two hash functions are required.

(a) What are the necessary and desirable properties of the second hash function?

(b) Can the same function be used for both the first and second hash functions? Justify your answer.

Total 50   The end